

## **APPENDIX A**

# Levers Assignment

[Click here for a picture of some real life examples](#)

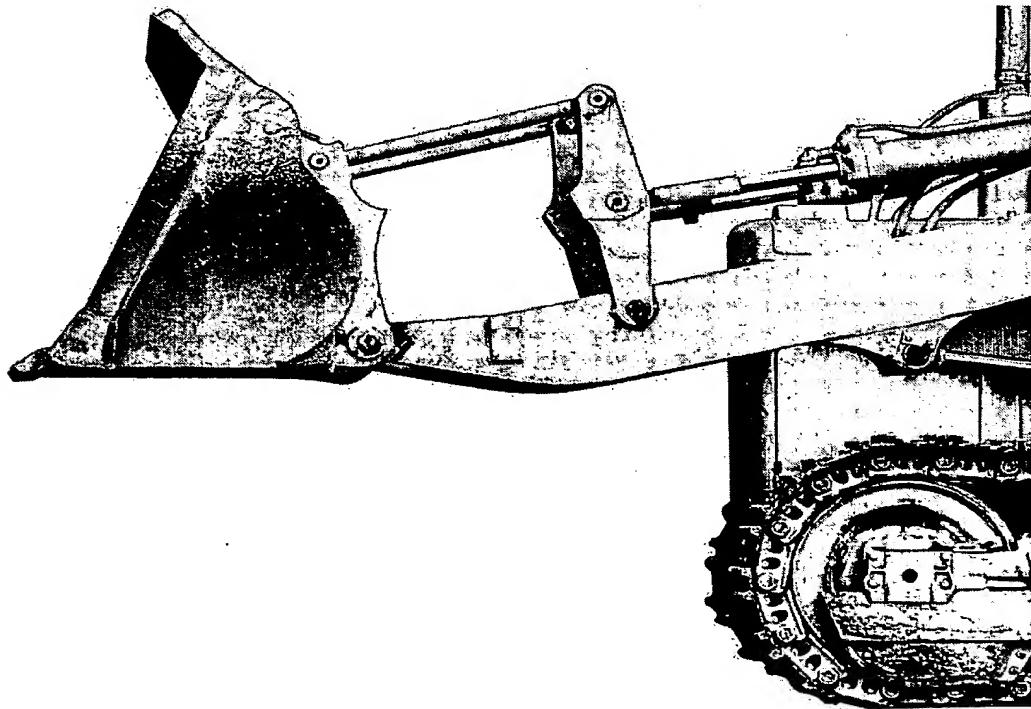
## Day 1 - Classwork and Homework Task

Read the handout entitled **Levers in Action** and answer the following question to be handed in on **Day 2**. *Be sure to include your name and desk number on the top right hand corner of the page that contains your answers. This homework is NOT to be done in groups but individually.*

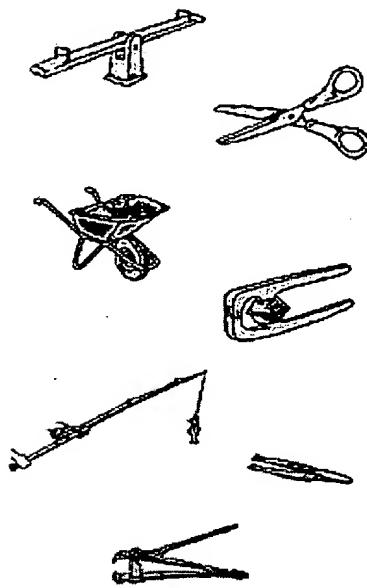
**Question:** Classify the type of lever shown below in the **front-end loader**. Make sure that you understand how the various levers interact to control the bucket.

## Day 2 - Classwork Task to be completed in groups of two

- Build the LEGO model shown on page 1 of the handout **Levers in Action**.
- How does this model use levers?
- Predict what will happen if you place a small object on the tray. Test your prediction with several different objects..
- How can the principle used in this model be used in a practical and useful way?
- Modify the model to compare the weights of heavier objects.
- Design cardboard scales to determine the weights of heavier objects.
- Change the device into a press. How does the press use a lever?



## L evers in Action



A lever is a rod or arm that tilts around a pivot to produce useful motion. One of the simple machines, the lever can make your work easier by amplifying motion or force, or by changing the direction of a force.

Here are some examples of levers or devices made up of levers. The three classes of levers are discussed later.

Seesaw (1st class)  
 Scissors (connected 1st class)  
 Wheelbarrow (2nd class)  
 Nutcracker (connected 2nd class)  
 Fishing rod (3rd class)  
 Tweezers (connected 3rd class)  
 Nail clippers (2nd class and connected 3rd class)

The following diagram shows the various parts of a lever in general.



The **load** is moved by the **effort** (a push or pull) making the lever tilt about the **fulcrum** (pivot).

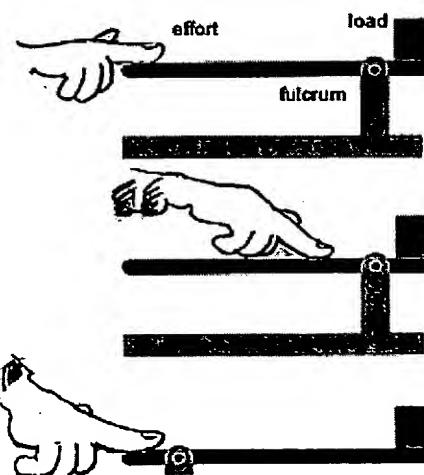
Familiarise yourself with levers by working through activities shown in *Italics*. There are drawings at the end of these notes for easy reference.

**1. First Class Lever** *Build the base and model 1 shown at the end of the notes. Predict what happens when you push down at the yellow tile on the handle.*

As you push down (effort), the beam tilts about the axle (fulcrum) and lifts the weighted brick (load).

Predict what happens when you move the handle closer to the fulcrum. You also lift the weighted brick, but you have to push down with more force.

**Main Ideas:** A first class lever has the fulcrum between the effort and the load. It is easier to lift a load with a first class



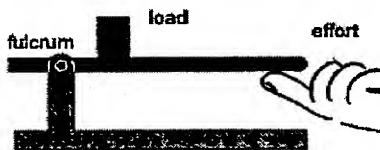
lever if you push down at a point far from the fulcrum.

#### Additional Information:

First class levers are often used to change the direction of forces. A seesaw is an example of a first class lever. First class levers can also be connected to each other, as in a pair of scissors.

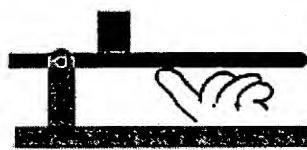
#### Extension:

Switch the places of the yellow tile and the weighted brick. Repeat the above investigation. Then change the location of the brick along the beam. (It takes a great effort to raise the brick, because you are pushing down so close to the fulcrum. However as the load is also moved closer to the fulcrum, the effort needed becomes less. )



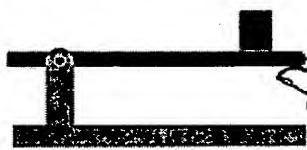
#### 2. Second Class Lever

*Build model 2. Predict what happens when you push up at the yellow tile on the handle.*

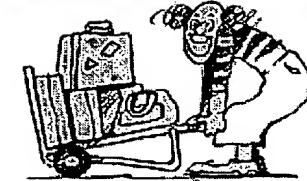


As you push up (effort), the beam tilts about the axle (fulcrum) and lifts the weighted brick (load).

Predict what happens when you push up on the handle closer to the fulcrum. You also lift the weighted brick, but you have to push up with more force.



A second class lever has the load between the fulcrum and the effort. The effort will always be less than the load. The farther from the fulcrum you apply the effort, the easier it is to lift the load.



#### Additional Information:

Second class levers are often used to lift heavy loads or to apply large forces. A wheelbarrow is a typical example of a second class lever. Second class levers can also be connected to each other, as in a nutcracker.

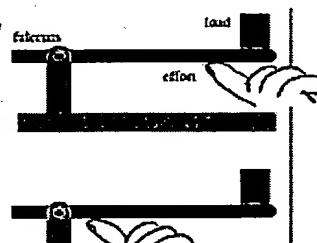
#### Extension:

Move the weighted brick closer to the yellow tile and repeat the above investigation. (It takes more effort to raise the load as it is moved further from the fulcrum. When the load closest to the fulcrum, it can be lifted with the least effort. )

#### 3. Third Class Lever

*Build model 3. Predict what happens when you push up on the handle at the yellow tile.*

As you push up (effort), the beam tilts about the axle (fulcrum) and lifts the weighted brick (load).



Predict what happens when you push up on the handle closer to the fulcrum. You also lift the weighted brick, but you have to push up with more force.

### Main Ideas:

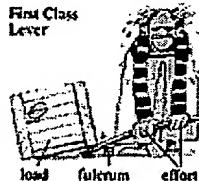
A third class lever has the effort between the fulcrum and the load. The farther from the fulcrum the load is located, the more effort you will have to apply to lift it.

### Additional Information:

Although third class levers can be used to lift loads or apply specific forces, as in a stapler, they are also used to amplify motion. A fishing rod is a typical example. The fulcrum is the hand at the end of the rod handle. A small motion of your other hand produces a large movement of the rod tip.

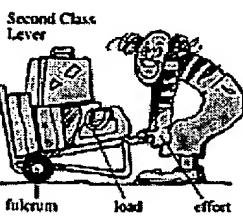
Third class levers can also be connected to each other, as in a pair of tweezers.

## 4. Lever Summary



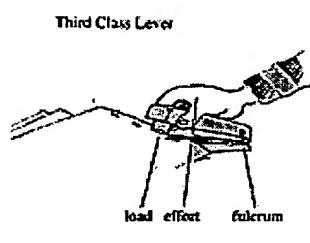
**First Class Levers** The fulcrum is between the effort and the load. A seesaw is an example of a simple first class lever. A pair of scissors is an example of two connected first class levers.

### Second Class Levers



The load is between the fulcrum and the effort. A wheelbarrow is an example of a simple second class lever. A nutcracker is an example of two connected second class levers.

### Third Class Levers



The effort is between the fulcrum and the load. A stapler or a fishing rod is an example of a simple third class lever. A pair of tweezers is an example of two connected third class levers.

### Force and Effort

To lift a load with the least effort:

- Place the load as close to the fulcrum as possible.
- Apply the effort as far from the fulcrum as possible.

Thanks to the Lego® group for the information contained in these notes.

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